Neutrosophic Sets and Systems, Vol. 81, 2025

University of New Mexico

Quality Assessment of Innovation and Entrepreneurship Talent Cultivation in Universities from the Perspective of Collaborative Education Under Triangular Neutrosophic Cubic Linguistic Hesitant Fuzzy Set

Qing Tan[1*], Chengcheng Wu[1], Xuan Li[1], Yao Yao[2]

[1]School of Business, Chizhou University, Chizhou, 247000, Anhui, China

[2]School of Literature and Media, Chizhou University, Chizhou, 247000, Anhui, China

*Corresponding author, E-mail: 18356637895@163.com

Abstract: A technique for representing mathematical models of confusion, ambiguity, confusion, inconsistency, and inconsistency, neutrophilic logic is built on non-standard analysis. While truth membership, indeterminacy membership, and falsity membership are independent, indeterminacy is explicitly quantified in the Neutrosophic set. In many circumstances where we deal with conflicting and partial information, this is crucial. Differential equations are widely used in science and engineering to represent issues, and one of the newest areas of study is the study of differential equations with uncertainty. We used the Triangular Neutrosophic Cubic Linguistic Hesitant Fuzzy Set with the decision-making methods. Two methods are used in this study. The RANCOM method is used to compute the criteria weights of Innovation and Entrepreneurship Talent Cultivation. The PROMETHEE method is used to rank the alternatives. nine criteria and ten alternatives are evaluated by three experts. A case study is conducted to show the validity of the proposed approach.

Keywords: Triangular Neutrosophic Cubic Linguistic Hesitant Fuzzy; Innovation and Entrepreneurship; Collaborative Education.

1. Introduction

A novel similarity metric between Atanassov's intuitionistic fuzzy values was introduced by Chen et al. To obtain the aggregated decision matrix of each decision-maker, Chen et al.' suggested method aggregates each decision-maker's decision matrix and attribute weights using the evidential reasoning methodology. The intuitionistic fuzzy Archimedean Heronian aggregation (IFAHA) operator was proposed by Liu et al. Some characteristics and specific situations of these suggested operators were defined by Liu et al. Based on the suggested I2LGA operator, Liu and Chen presented a novel MAGDM technique using the I2LI. Each alternative's weighted positive and negative scores were determined by Chen et al. Using the new scoring function and the linear programming (LP) methodology, Wang and Chen presented a novel MADM approach[1], [2].

Decision-makers find it difficult to provide an accurate assessment of complicated issues in real-world decision-making situations because of both subjective and objective elements. Decision-makers typically have some reluctance to evaluate the ambiguous and uncertain quantities. One of the extensions of fuzzy set theory is intuitionistic fuzzy sets (IFS)[3], [4]. It has been discovered that IFS, which was initially presented by Atanassov, is consistent with handling vagueness among several higher order fuzzy sets. When there is insufficient information available to describe the impreciseness using the traditional fuzzy set, the idea of IFS can be seen as a suitable solution. Later, Liu and Yuan combined intuitionistic fuzzy sets with triangle fuzzy numbers to create triangular intuitionistic fuzzy sets[5], [6].

The triangle intuitionistic fuzzy set's primary feature is that its membership function and non-membership function have triangular fuzzy values instead of exact ones. As a generalization of the classic set, fuzzy set, and intuitionistic fuzzy set, Wang et al. Recently, I recently published a single-valued neutrosophic set, which is a subclass of a neutrosophic set introduced by Smarandache[7], [8]. In addition to dealing with inconsistent, indeterminate, and incomplete information, the single-valued neutrosophic set can independently express truth-membership degree, indeterminacy-membership degree, and falsity-membership degree. Because of the imperfections in the knowledge that humans acquire or perceive from the outside world, all the elements that are defined by the single-valued neutrosophic set are very appropriate for human thought.

For instance, if the proposition is "Movie X would be hit," the human brain is undoubtedly unable to produce exact yes/no responses since indeterminacy is the area where one is unsure of the proposition's value between truth and falsity. It goes without saying that the intuitionistic fuzzy set is unable to handle and express indeterminacy and inconsistent information, whereas the neutrosophic components are better suited to do so. As a result, the single-valued neutrosophic set has developed quickly and has many uses[9], [10]. A few persuasive techniques were used to suggest the Hesitant Fuzzy Set and the Statement of Fuzzy Set, which permit an element to belong to a precise set.

Fuzzy sets and intuitionistic fuzzy sets are generalizations of cubic sets, which were developed by Jun et al. They include two representations: one for the degree of membership and another for the degree of non-membership. Non-membership is considered over the regular fuzzy set, whilst the membership function is held in the form of an interval.

2. Triangular neutrosophic cubic linguistic hesitant fuzzy numbers

This section shows the definition of the triangular neutrosophic cubic linguistic hesitant fuzzy numbers (TNCLHFN)[11], [12]. Let two TNCLHFNs such as:

$$A_1 = \begin{Bmatrix} S_{\theta_1}, [u_1, v_1, x_1]; ([B_1^-, B_1^+]; B_1) \\ ([C_1^-, C_1^+]; C_1), ([D_1^-, D_1^+]; D_1) \end{Bmatrix} \tag{1}$$

$$A_2 = \begin{Bmatrix} S_{\theta_2}, [u_2, v_2, x_2]; ([B_2^-, B_2^+]; B_2) \\ ([C_2^-, C_2^+]; C_2), ([D_2^-, D_2^+]; D_2) \end{Bmatrix} \tag{2}$$

$$A_1 + A_2 = \begin{Bmatrix} S_{\theta_{a_1+a_2}}, [u_1 + u_2, v_1 + v_2, x_1 + x_2], \\ \begin{pmatrix} [\min(B_1^-, B_2^-), \min(B_1^+, B_1^+)] \\ , \max(B_1, B_2) \end{pmatrix}, \\ \begin{pmatrix} [\min(C_1^-, C_2^-), \min(C_1^+, C_1^+)], \\ \max(C_1, C_2) \end{pmatrix}, \\ \begin{pmatrix} [\min(D_1^-, D_2^-), \min(D_1^+, D_1^+)], \\ \max(D_1, D_2) \end{pmatrix} \end{Bmatrix} \tag{3}$$

$$A_1 - A_2 = \begin{Bmatrix} S_{\theta_{a_1-a_2}}, [u_1 - u_2, v_1 - v_2, x_1 - x_2], \\ \begin{pmatrix} [\min(B_1^-, B_2^-), \min(B_1^+, B_1^+)], \\ \max(B_1, B_2) \end{pmatrix}, \\ \begin{pmatrix} [\min(C_1^-, C_2^-), \min(C_1^+, C_1^+)], \\ \max(C_1, C_2) \end{pmatrix}, \\ \begin{pmatrix} [\min(D_1^-, D_2^-), \min(D_1^+, D_1^+)], \\ \max(D_1, D_2) \end{pmatrix} \end{Bmatrix} \tag{4}$$

$$A_1 A_2 = \begin{Bmatrix} S_{\theta_{a_1 a_2}}, [u_1 u_2, v_1 v_2, x_1 x_2], \\ \begin{pmatrix} [\min(B_1^-, B_2^-), \min(B_1^+, B_1^+)], \\ \max(B_1, B_2) \end{pmatrix}, \\ \begin{pmatrix} [\min(C_1^-, C_2^-), \min(C_1^+, C_1^+)], \\ \max(C_1, C_2) \end{pmatrix}, \\ \begin{pmatrix} [\min(D_1^-, D_2^-), \min(D_1^+, D_1^+)] \\ , \max(D_1, D_2) \end{pmatrix} \end{Bmatrix} \tag{5}$$

$$\omega A_1 = \begin{Bmatrix} S_{\theta_{\omega a_1}}, [\omega u_1, \omega v_1, \omega x_1], \\ ([B_1^-, B_1^+], B_1), \\ ([C_1^-, C_1^+], C_1), \\ ([D_1^-, D_1^+], D_1) \end{Bmatrix} \tag{6}$$

$$A_1^\omega = \begin{Bmatrix} S_{\theta_{a_1^\omega}}, [u_1^\omega, v_1^\omega, x_1^\omega], \\ ([(B_1^-)^\omega, (B_1^+)^\omega], 1 - (1 - B_1)^\omega), \\ ([(C_1^-)^\omega, (C_1^+)^\omega], 1 - (1 - C_1)^\omega), \\ ([(D_1^-)^\omega, (D_1^+)^\omega], 1 - (1 - D_1)^\omega) \end{Bmatrix} \tag{7}$$

$$\sum_{j=1}^{n} w_j n_j \begin{Bmatrix} S\prod_{j=1}^{n} a_j, \left[\sum_{j=1}^{n} u_1^{w_j}, \sum_{j=1}^{n} v_1^{w_j}, \sum_{j=1}^{n} x_1^{w_j}\right], \\ \begin{pmatrix} \begin{bmatrix} 1-\prod_{j=1}^{n}(1-B_1^-)^{w_j}, \\ 1-\prod_{j=1}^{n}(1-B_1^+)^{w_j} \end{bmatrix}, \\ 1-\prod_{j=1}^{n}(1-B_1)^{w_j} \end{pmatrix}, \\ \begin{pmatrix} \left[\prod_{j=1}^{n}(C_1^-)^{w_j}, \prod_{j=1}^{n}(C_1^+)^{w_j}\right], \\ \prod_{j=1}^{n}(C_1)^{w_j} \end{pmatrix}, \\ \begin{pmatrix} \left[\prod_{j=1}^{n}(D_1^-)^{w_j}, \prod_{j=1}^{n}(D_1^+)^{w_j}\right], \\ \prod_{j=1}^{n}(D_1)^{w_j} \end{pmatrix} \end{Bmatrix} \tag{8}$$

3. A hybrid TNCLHFNs-RANCOM-PROMETHEE method for solving MCDM problems

This section shows the steps of the proposed approach. RANCOM is used to compute the criteria weights. The PROMETHEE method is used to rank the alternatives. These methods are used under the neutrosophic sets to deal with the uncertainty and vague information.

The RANCOM Method

The steps of this method are organized as follows[13], [14]:

1. Construct the decision matrix

The decision matrix is built based on the opinions of the experts and decision makers. These matrices are used the neutrosophic numbers.

2. Apply the score function

The score function is applied to obtain crisp values in the decision matrix.

3. Aggrege the decision matrix

The decision matrix values are aggregated using the average method.

4. Compute the rank of the criteria

5. Generate the ranking comparison matrix between the criteria.

$$q_{kj} = \begin{bmatrix} q_{11} & \cdots & q_{1n} \\ \vdots & \ddots & \vdots \\ q_{n1} & \cdots & q_{nn} \end{bmatrix} \tag{9}$$

Where

$$q_{kj} = \begin{cases} 1, & if\ S(Q_j) < S(Q_k), \\ 0.5, & if\ S(Q_j) = S(Q_k), \\ 0, & if\ S(Q_j) > S(Q_k) \end{cases} \tag{10}$$

6. Compute the summed criteria weight

$$e_j = \sum_{k=1}^{n} q_{kj} \tag{11}$$

7. Compute subjective weights

$$w_j = \frac{e_j}{\sum_{j=1}^{n} e_j} \tag{12}$$

The PROMETHEE Method

This method is used to rank the alternatives.

1. Normalize the decision matrix

$$n_{ij} = \frac{x_{ij} - \min(x_{ij})}{\max(x_{ij}) - \min(x_{ij})} \tag{13}$$

$$n_{ij} = \frac{max - x_{ij}}{\max(x_{ij}) - \min(x_{ij})} \tag{14}$$

2. Compute the relative difference between the alternatives.

3. Compute the preference function

$$p_j(a,b) = 0 \quad if\ n_{aj} \leq n_{bj} \tag{15}$$

$$p_j(a,b) = \left(n_{aj} - n_{bj}\right)\ if\ n_{aj} > n_{bj} \tag{16}$$

4. Combined the preferences functions

$$y(a,b) = \left[\sum_{j=1}^{n} w_j\, p_j(a,b)\right] / \sum_{j=1}^{n} w_j \tag{17}$$

5. Compute the leaving and entering outranking flows

$$F^+ = \frac{1}{m-1} \sum_{b=1}^{m} y(a,b) \tag{18}$$

$$F^- = \frac{1}{m-1} \sum_{b=1}^{m} y(a,b) \tag{19}$$

6. Compute the net outranking flow

$$F(a) = F^+(a) - F^-(a) \tag{20}$$

7. Ranking the alternatives.

4. Case Study

This section shows the results of the proposed approach to computing the criteria weights and rank the alternatives. This study uses 9 criteria and 10 alternatives to be evaluated: Practical Training, International Exchange, Interdisciplinary Learning Opportunities

Soft Skills, Employment Outcomes, Personalized Learning, Entrepreneurship, Technology Integration in Education, Industry-Academia Collaboration. These criteria are evaluated using three experts and decision makers. The alternatives are University-Industry Joint Training Programs, Entrepreneurial Incubators, Community-Engaged, Work-Integrated Learning, Project-Based Collaborative Learning, International Exchange, Dual-Degree and Interdisciplinary Programs, Research-Based Collaborative Education, AI-Powered Personalized Learning Systems, Lifelong Learning

Then we use the neutrosophic numbers to evaluate ethe criteria and alternatives as shown in Table 1. Then we apply the score function to obtain crisp values. Then we combined these values into a single matrix. We combined these values using the average method. Then we applied the steps to compute the criteria weights and rank the alternatives.

Table 1. The experts 'opinions.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}
A_2	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([0.1,0.3],0.6)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([0.1,0.3],0.6)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}
A_3	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}
A_4	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}
A_5	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}
A_6	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([0.1,0.3],0.6)}
A_7	{S2,[0.4,0.5,0.6],([0.2,0.	{S1,[0.5,0.4,0.7],([0.7,0.	{S2,[0.4,0.5,0.6],([0.2,0.	{S3,[0.1,0.2,0.3],([0.3,0.	{S3,[0.1,0.2,0.3],([0.3,0.	{S1,[0.5,0.4,0.7],([0.7,0.	{S2,[0.4,0.5,0.6],([0.2,0.	{S2,[0.4,0.5,0.6],([0.2,0.	{S1,[0.3,0.4,0.6],([0.1,0.

	4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}
A_8	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}
A_9	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([0.1,0.3],0.6)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([0.1,0.3],0.6)}	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([0.1,0.3],0.6)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([0.1,0.3],0.6)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}
A_{10}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}
	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}
A_2	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}
A_3	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}
A_4	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([0.1,0.3],0.6)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}
A_5	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}
A_6	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([0.1,0.3],0.6)}

A7	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}
A8	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([0.1,0.3],0.6)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}
A9	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([0.1,0.3],0.6)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}
A10	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}
	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A1	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}
A2	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([0.1,0.3],0.6)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([0.1,0.3],0.6)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}
A3	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}
A4	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([0.1,0.3],0.6)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([0.1,0.3],0.6)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}
A5	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}
A6	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([

	0.5,0.8],0.4)}	0.4,0.7],0.3)}	0.4,0.7],0.5)}	0.1,0.3],0.6)}	0.1,0.12],0.11)}	0.1,0.12],0.11)}	0.4,0.6],0.1)}	0.5,0.8],0.4)}	0.1,0.3],0.6)}
A7	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}
A8	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}
A9	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([0.1,0.3],0.6)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([0.1,0.3],0.6)}	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([0.1,0.3],0.6)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S2,[0.7,0.8,0.9],([0.2,0.4],0.1),([0.3,0.5],0.5),([0.1,0.3],0.6)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}
A10	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}	{S3,[0.1,0.2,0.3],([0.3,0.6],0.1),([0.2,0.4],0.2),([0.5,0.8],0.4)}	{S2,[0.4,0.5,0.6],([0.2,0.4],0.3),([0.2,0.5],0.3),([0.1,0.12],0.11)}	{S1,[0.3,0.4,0.6],([0.1,0.4],0.2),([0.3,0.5],0.5),([0.4,0.6],0.1)}	{S1,[0.1,0.3,0.5],([0.2,0.7],0.3),([0.4,0.6],0.1),([0.4,0.7],0.3)}	{S2,[0.2,0.4,0.4],([0.3,0.6],0.2),([0.5,0.7],0.5),([0.2,0.7],0.1)}	{S1,[0.5,0.4,0.7],([0.7,0.9],0.3),([0.3,0.8],0.6),([0.4,0.7],0.5)}

Then we rank the criteria. Eq. (9) and Eq. (10) are used to generate ranking comparison matrix. Then we compute the summed criteria weight suing Eq. (11). Then we compute subjective weights using Eq. (12) as shown in Fig 1.

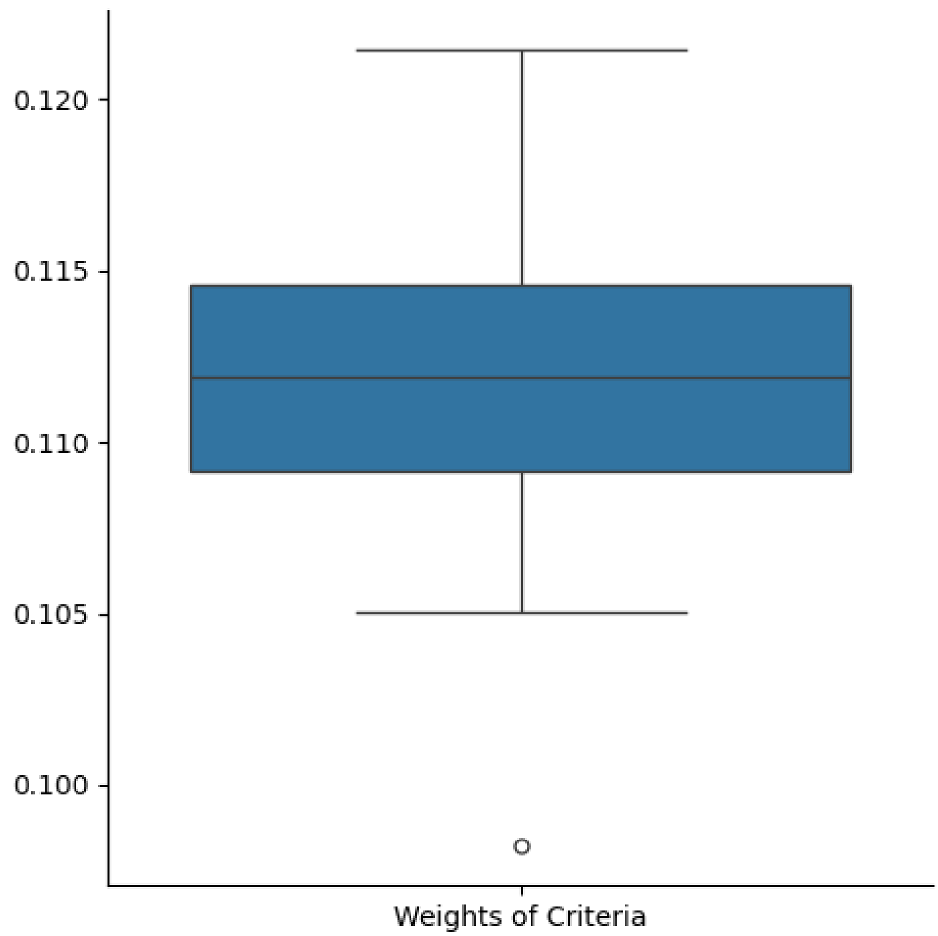

Fig 1. The criteria importance.

The PROMETHEE Method

Eq. (13) is used to normalize the decision matrix using Eqs. (13 and 14) as shown in Table 2. Then we compute the relative difference between the alternatives as shown in Fig 2. Then we compute the preference function between the alternatives as shown in Fig 3. Then we combined these preference functions into a single matrix. Then we compute the leaving and entering flows. Then we compute the net outranking flow. Then we ranked the alternatives as shown in Fig 4.

Table 2. The normalization matrix.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	0.119385	0.327731	1	0.710526	0.360185	0	0.574468	0.273342	0
A_2	0.406619	0.282913	0	0.676692	1	0.45	0.446809	0.548038	0.333333
A_3	0.524823	0.610644	1	0.710526	0.411111	0.741667	1	0.47226	1
A_4	0.723404	0.473389	0.338889	0	0.187037	0.347619	0.425532	0.691475	0.35
A_5	1	0.191877	0.566667	0.616541	0.116667	0.263095	0	1	0.45
A_6	0.425532	0.176471	0.537963	1	0.444444	0.578571	0.358156	0.188092	0.477778
A_7	0	1	0.116667	0.755639	0.555556	0.721429	0.141844	0	0.280556

A8	0.358156	0.663866	0.411111	0.913534	0.45	1	0.70922	0.369418	0
A9	0.609929	0	0.651852	0.883459	0.35	0.3	1	0.548038	0.333333
A10	0.574468	0.352941	0.783333	0.676692	0	0.360714	0.489362	0.47226	1

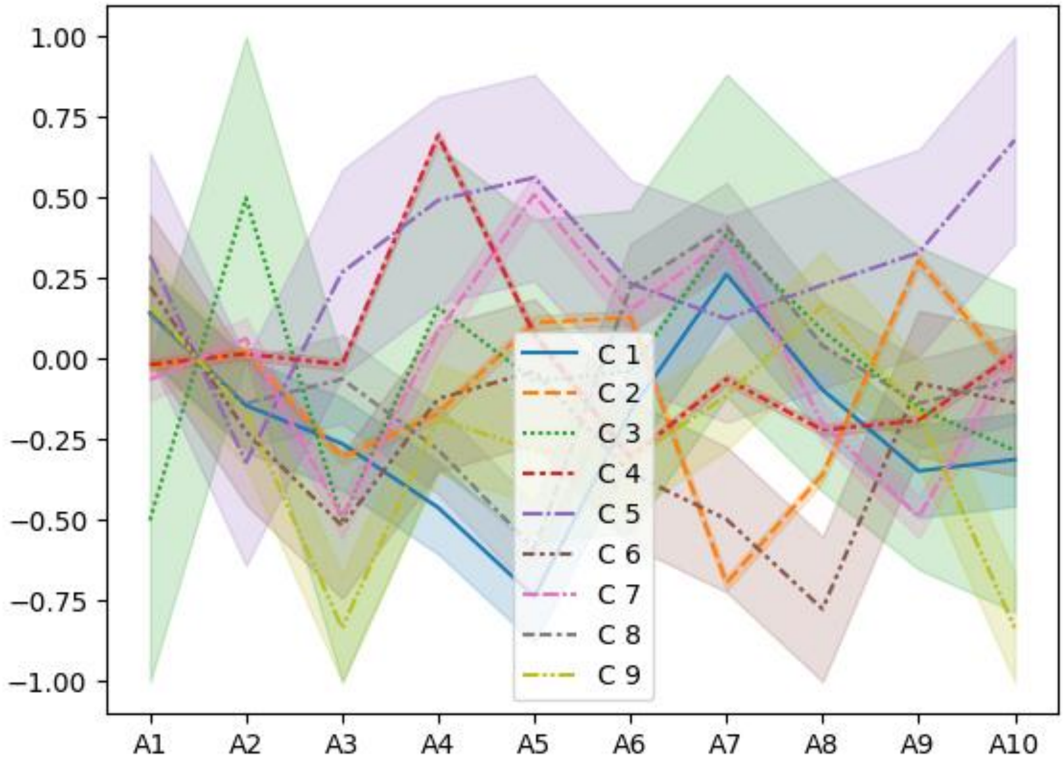

Fig 2-a. The difference between the alternatives.

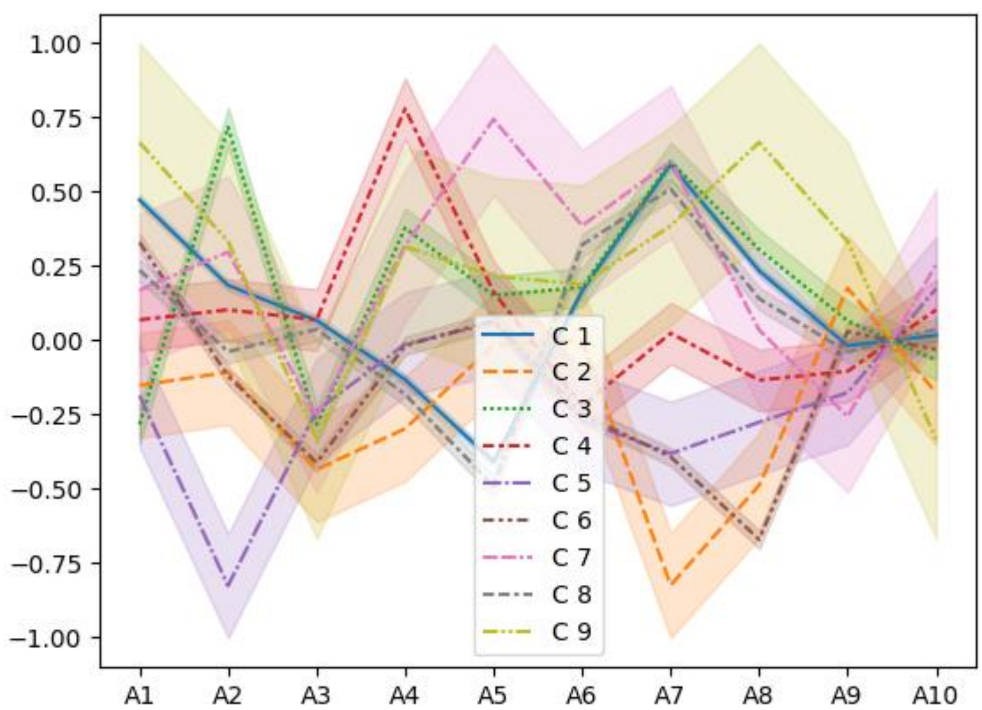

Fig 2-b. The difference between the alternatives.

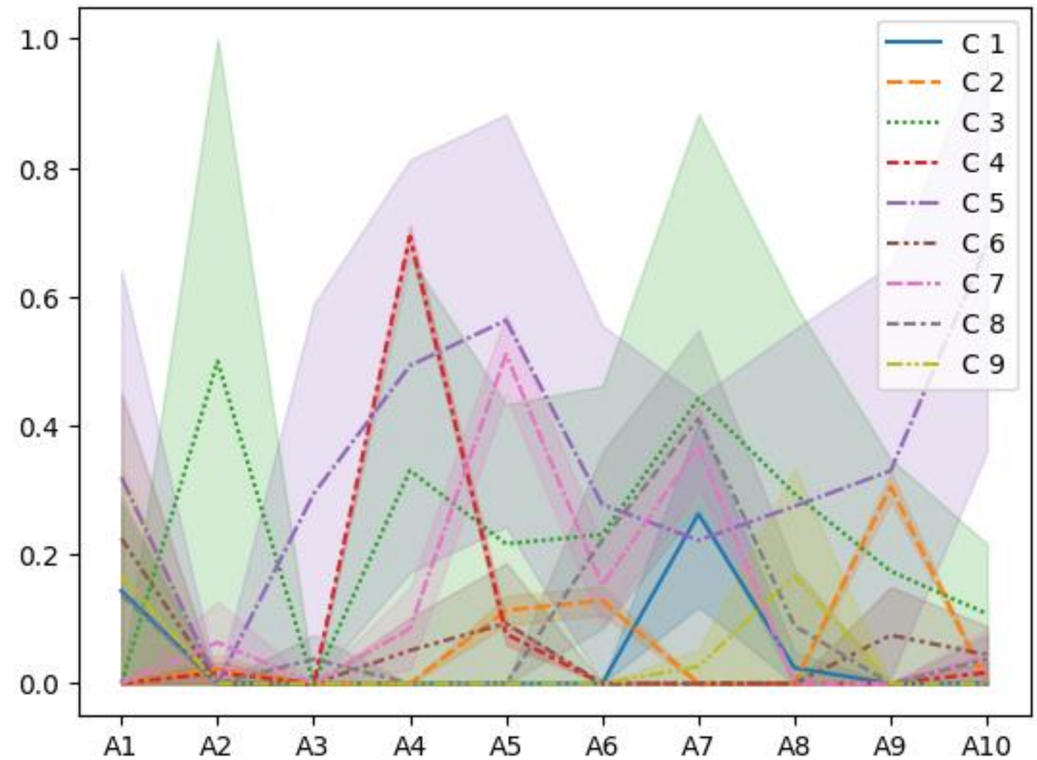

Fig 3-a. The preference values.

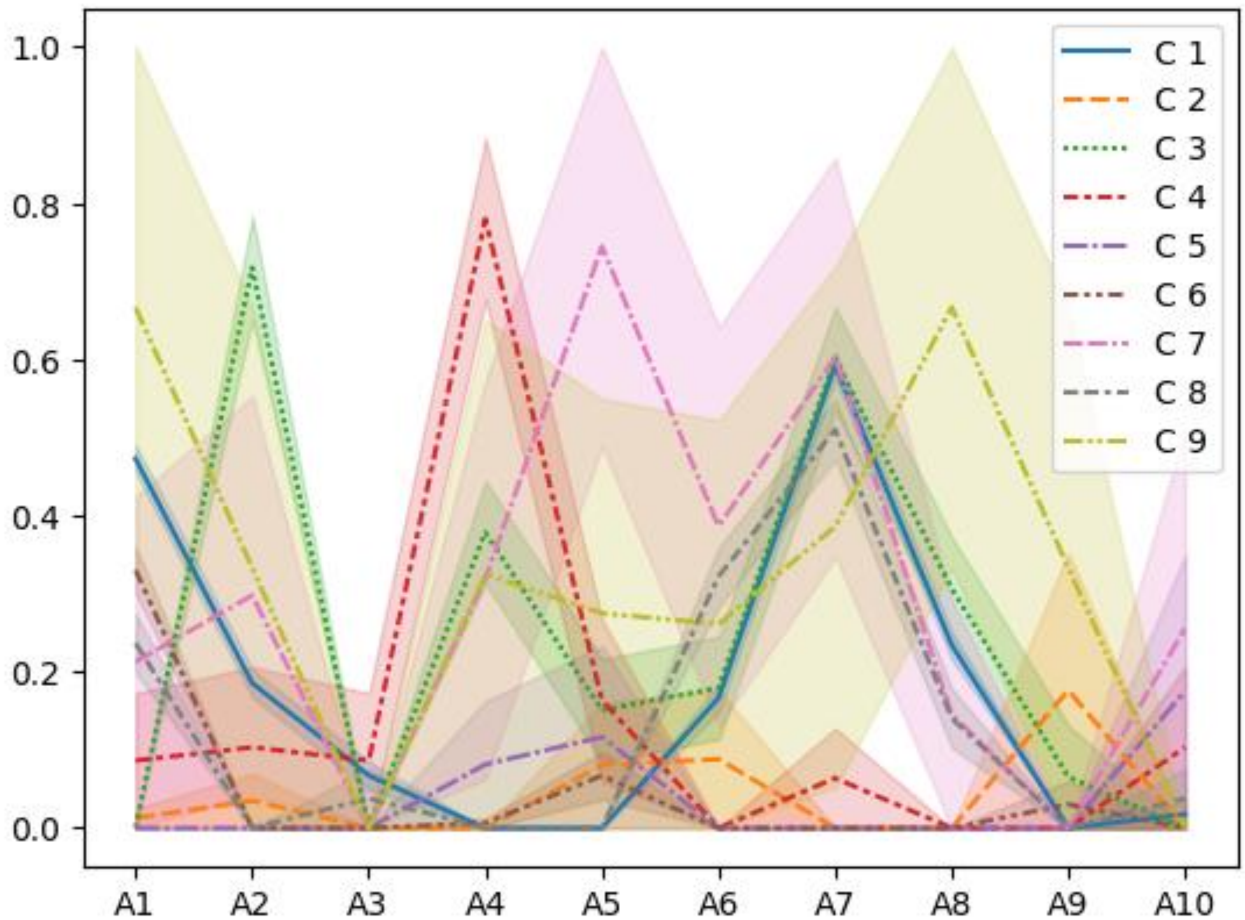

Fig 3-b. The preference values.

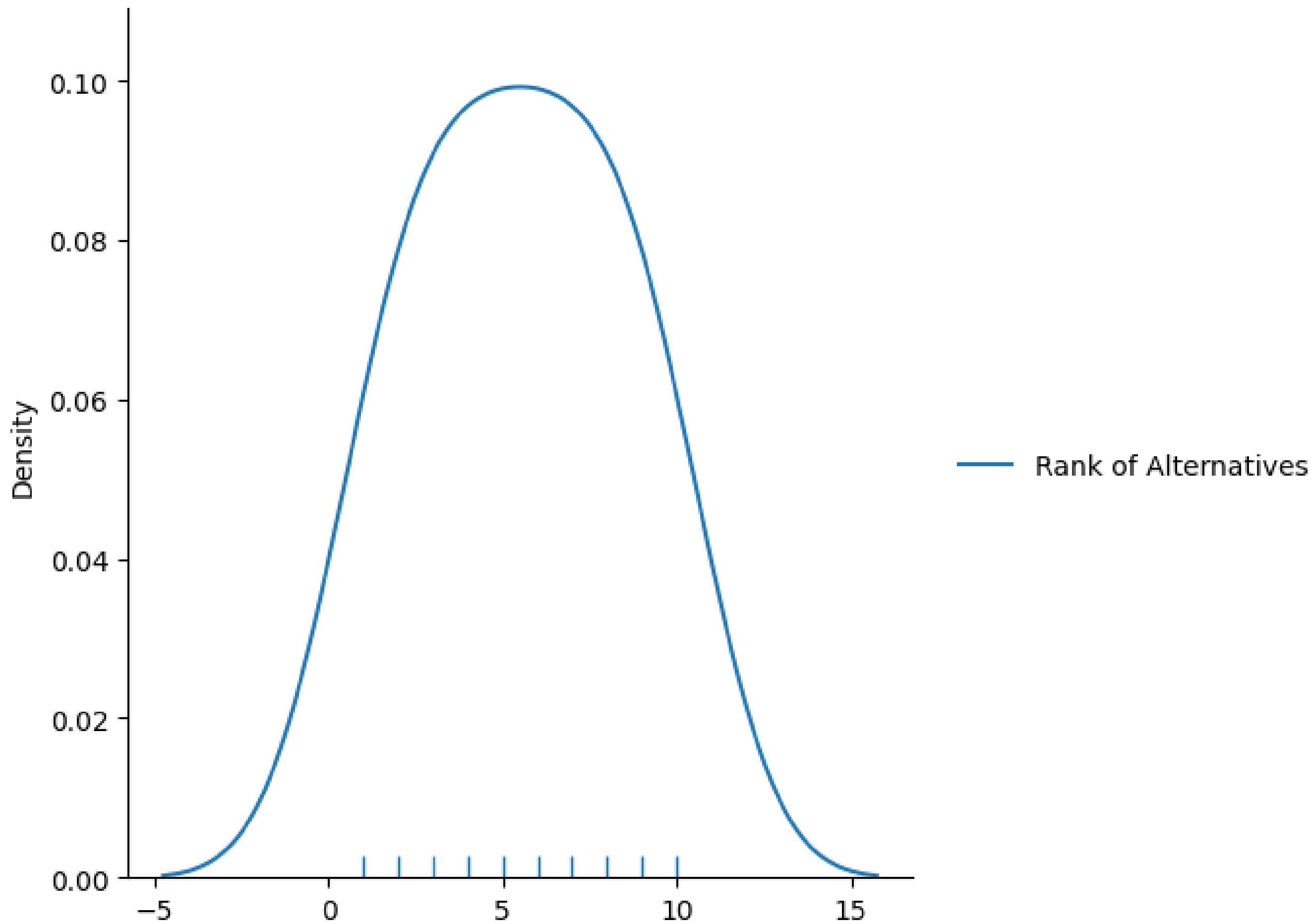

Fig 4. The rank of alternatives.

Then we applied the sensitivity analysis between the ranks of the alternatives. We conducted ten cases in the criteria weights to show the rank of the alternatives under different cases as shown in fig 5. Then we applied the proposed approach to obtain the rank of alternatives.

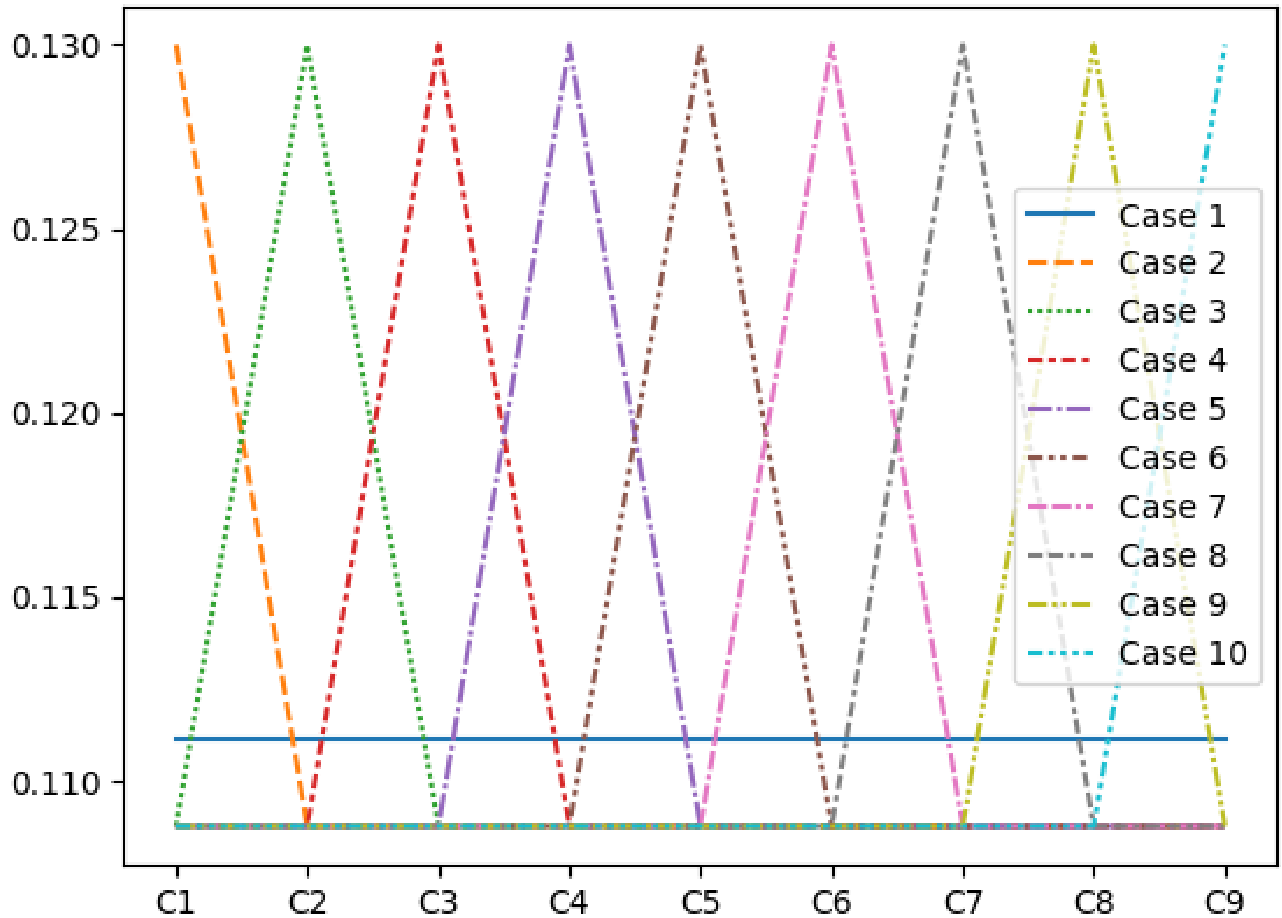

Fig 5. The various criteria weights.

In the criteria weights, we put all criteria with the same weight, then we rank the alternatives under this case, we show the alternative 1 is the best and alternative 3 is the worst. In the second case we increase the first criterion weight with 13%, then we put all other criteria with the same weight. In this case, we show alternative 1 is the best and alternative 3 is the worst. In the third case we increase the second criterion weight with 13%, then we put all other criteria with the same weight. In this case, we show alternative 1 is the best and alternative 3 is the worst. In the fourth case we increase the third criterion weight with 13%, then we put all other criteria with the same weight. In this case, we show alternative 1 is the best and alternative 3 is the worst. Fig 6 shows the net ranking of the alternatives. Fig 7 shows rank of the alternatives.

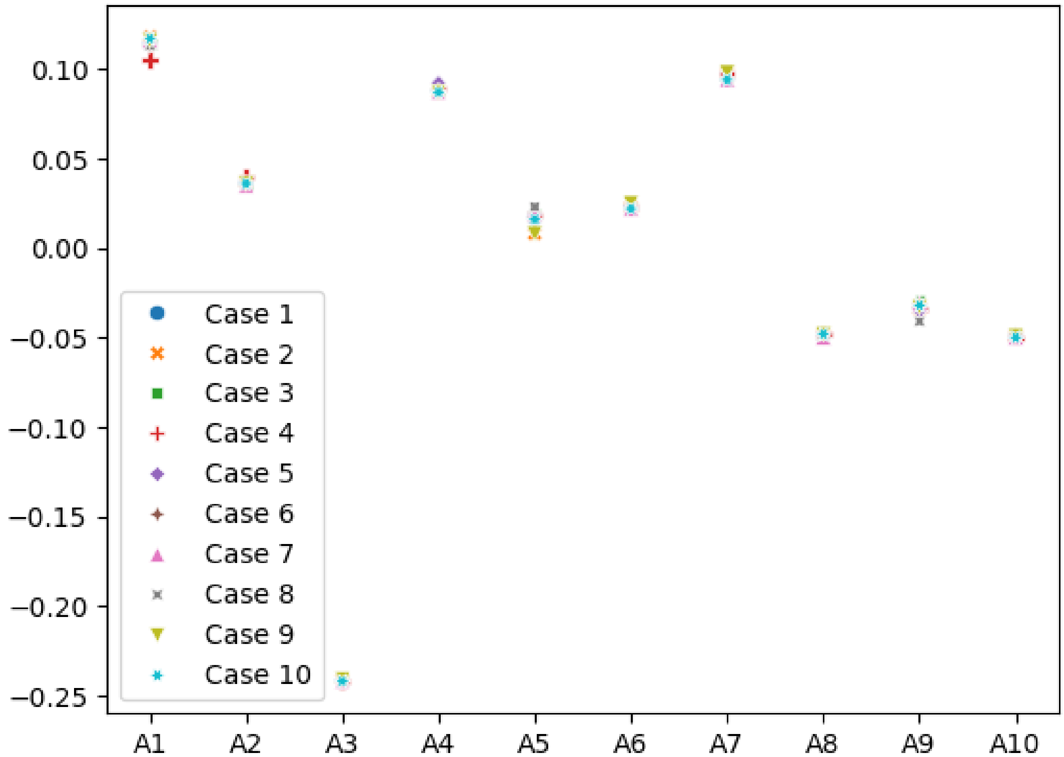

Fig 6. The net ranking of the alternatives.

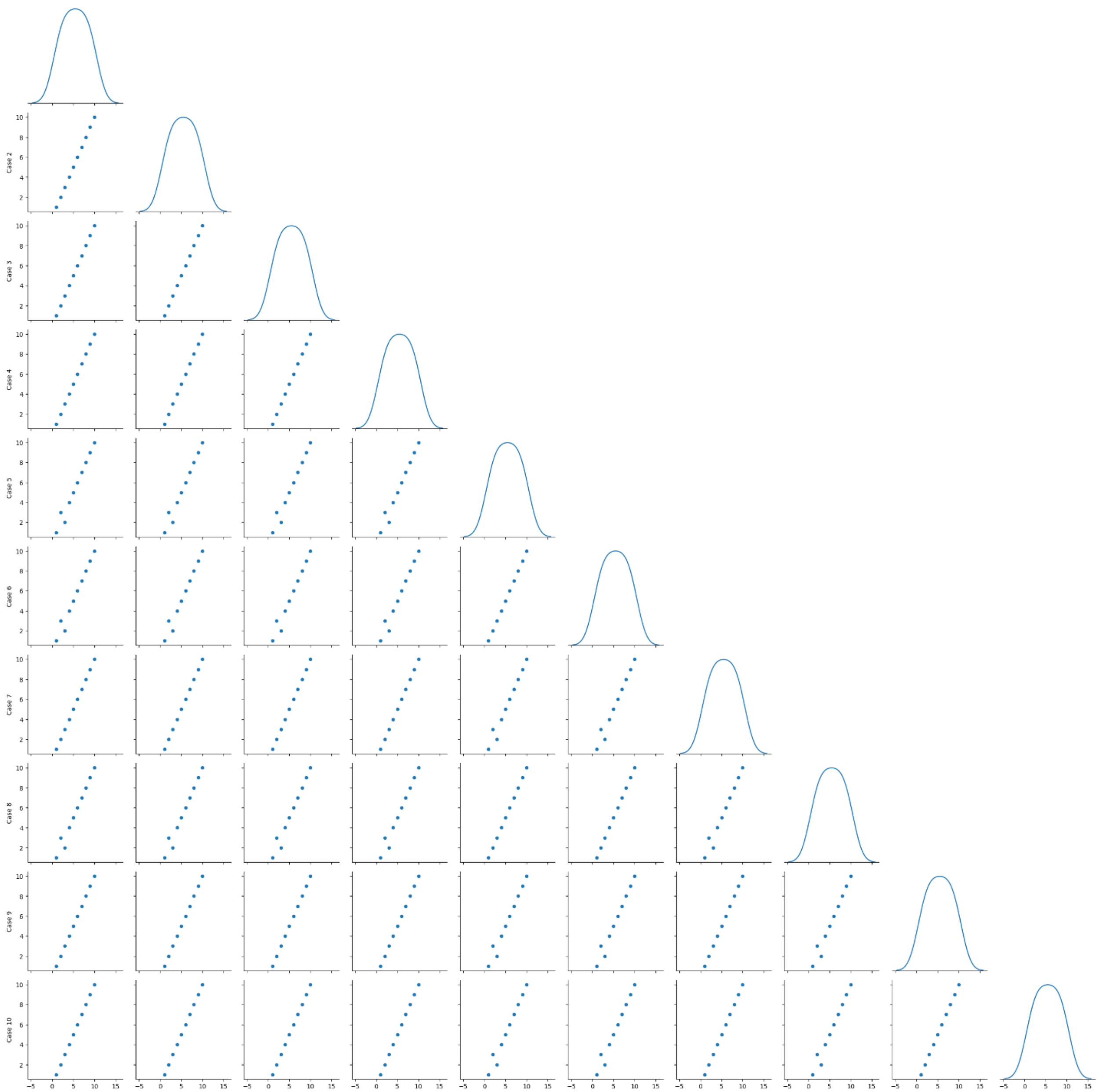

Fig 7. The various ranks.

5. Conclusions

In this study, a decision-making model is developed for evaluation of Innovation and Entrepreneurship Talent Cultivation. Two MCDM methods are used such as RANCOM method to compute the criteria weights and the PROMETHEE method to rank the alternatives. These methods are used under the Triangular Neutrosophic Cubic Linguistic Hesitant Fuzzy Set to deal with uncertainty and vague information. 9 criteria and 10 alternatives are evaluated by three experts and decision makers. The results show alternative 1 is the best and alternative 3 is the worst. The sensitivity analysis was conducted with ten cases to show the ranks of the alternatives. The results show the ranks of the alternative are stable in different cases.

Acknowledgment

This work was supported by the Anhui Province Quality Engineering Project: College of Digital Intelligence Business Modern Industry, Chizhou University (Grant Nos.2023cyts056);and Offline first-class course: New Business Interdisciplinary Comprehensive Training(Grant Nos.2023xxkc357).

References

[1] R. Biswas, "On fuzzy sets and intuitionistic fuzzy sets," *Notes Intuitionistic Fuzzy Sets*, vol. 3, no. 1, 1997.

[2] H. Bustince and P. Burillo, "Vague sets are intuitionistic fuzzy sets," *Fuzzy sets Syst.*, vol. 79, no. 3, pp. 403–405, 1996.

[3] G. Takeuti and S. Titani, "Intuitionistic fuzzy logic and intuitionistic fuzzy set theory," *J. Symb. Log.*, vol. 49, no. 3, pp. 851–866, 1984.

[4] F. Smarandache, "Neutrosophic set is a generalization of intuitionistic fuzzy set, inconsistent intuitionistic fuzzy set (picture fuzzy set, ternary fuzzy set), pythagorean fuzzy set, spherical fuzzy set, and q-rung orthopair fuzzy set, while neutrosophication is a generalization of regret theory, grey system theory, and three-ways decision (revisited)," *J. new theory*, no. 29, pp. 1–31, 2019.

[5] E. Afful-Dadzie, Z. K. Oplatkova, and L. A. Beltran Prieto, "Comparative state-of-the-art survey of classical fuzzy set and intuitionistic fuzzy sets in multi-criteria decision making," *Int. J. Fuzzy Syst.*, vol. 19, pp. 726–738, 2017.

[6] A. Lu and W. Ng, "Vague sets or intuitionistic fuzzy sets for handling vague data: which one is better?," in *International conference on conceptual modeling*, Springer, 2005, pp. 401–416.

[7] A. Fahmi, F. Amin, and H. Ullah, "Multiple attribute group decision making based on weighted aggregation operators of triangular neutrosophic cubic fuzzy numbers," *Granul. Comput.*, vol. 6, pp. 421–433, 2021.

[8] A. Fahmi, M. Aslam, and M. Riaz, "New approach of triangular neutrosophic cubic linguistic hesitant fuzzy aggregation operators," *Granul. Comput.*, vol. 5, pp. 527–543, 2020.

[9] M. Aslam, A. Fahmi, F. A. A. Almahdi, and N. Yaqoob, "Extension of TOPSIS method for group decision-making under triangular linguistic neutrosophic cubic sets," *Soft Comput.*, vol. 25, pp. 3359–3376, 2021.

[10] A. U. Rehman, M. Gulistan, M. Ali, M. M. Al-Shamiri, and S. Abdulla, "Development of neutrosophic cubic hesitant fuzzy exponential aggregation operators with application in environmental protection problems," *Sci. Rep.*, vol. 13, no. 1, p. 5262, 2023.

[11] A. Fahmi, F. Amin, M. Khan, and F. Smarandache, "Group decision making based on triangular neutrosophic cubic fuzzy einstein hybrid weighted averaging operators," *Symmetry (Basel)*., vol. 11, no. 2, p. 180, 2019.

[12] F. Amin and A. Fahmi, "Human immunodeficiency virus (HIV) infection model based on triangular neutrosophic cubic hesitant fuzzy number," *Int. J. Biomath.*, vol. 12, no. 05, p. 1950055, 2019.

[13] J. Więckowski, B. Kizielewicz, A. Shekhovtsov, and W. Sałabun, "RANCOM: A novel approach to identifying criteria relevance based on inaccuracy expert judgments," *Eng. Appl. Artif. Intell.*, vol. 122, p. 106114, 2023.

[14] J. Więckowski, J. Wątróbski, and W. Sałabun, "Inaccuracies in expert judgment: Comparative analysis of RANCOM and AHP methods in housing location selection problem," *IEEE Access*, 2024.

Received: Sep 8, 2024. Accepted: Feb 14, 2025